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DIETS OF BREEDING AND NONBREEDING CALIFORNIA SPOTTED OWLS

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ABSTRACT.—We examined diets of breeding and nonbreeding California Spotted Owls (*Strix occidentalis occidentalis*) from the central Sierra Nevada by analyzing cast pellets. Frequencies of large and small mammal prey were significantly different between diets of breeding and nonbreeding pairs. Relative proportions of large mammal prey and biomass were significantly greater within the diet of breeding pairs than nonbreeding pairs. Further, relative proportions of small mammal prey and biomass were significantly less within the diet of breeding pairs than nonbreeding pairs. We suggest that breeding success was correlated to the greater relative proportion of large mammal prey within the diet of California Spotted Owls. Whether our results reflected prey availability was not determined.

Several studies have documented that mammals, particularly woodrats (*Neotoma* spp.) and the Northern Flying Squirrel (*Glaucomys sabrinus*) are primary food resources for Northern Spotted Owls (*Strix occidentalis caurina*) in the Pacific Northwest (Solis 1983; Forsman et al. 1984). However, little is known about the diet of the California Spotted Owl (*Strix occidentalis occidentalis*) in the Sierra Nevada. Only 2 studies are available that report food habits of 8 and 2 pairs, respectively, of spotted owls from the region (Marshall 1942; Laymon 1985). Barrows (1985, 1987) reported that breeding success of Northern Spotted Owls apparently varied with diet, with a preponderance of large prey taken during successful breeding years. We examined the diet of breeding and nonbreeding California Spotted Owls in the central Sierra Nevada to test the generality of Barrows' (op. cit.) finding.

STUDY AREA AND METHODS

The study area was located in the central Sierra Nevada approximately 10 km north of Georgetown, Eldorado County, California. The study area was about 355 km^2 with elevation ranging from 366–2257 m. Habitats were typical of middle elevation mixed conifer zones of the Sierra Nevada (Verner and Boss 1980).

We located roosting and nesting owls following standard survey techniques (Forsman 1983). Breeding status was determined by feeding live mice (*Peromyscus* spp.) to either adult owl (Forsman 1983). Owl pairs were considered breeding if they nested and at least one juvenile owl was fledged. We collected spotted owl pellets from below adult roosts from May–August 1986 and 1987.

Mammalian prey were identified and counted from skulls or reconstructed appendicular skeletons, whichever gave the highest count (Forsman et al. 1984). Avian prey were identified and counted from bills. Insects were identified and counted from exoskeletal remains (Forsman et al. 1984). Mammal species were separated into 2 size classes: large, mean weight > 100 g; and small, mean weight < 100 g, which corresponds to a natural dicotomy in the size of prey taken by spotted owls (Barrows 1985). We estimated mean weight of individual prey species from specimens and records at the Museum of Vertebrate Zoology (MVZ), Berekeley, CA. We used only specimens and records that were collected from within and surrounding counties of the study area.

We estimated diet composition for each owl pair from frequency and percent biomass of prey species and prey groups. We used *heterogeneity* χ^2 analyses to estimate if diets of breeding and nonbreeding pairs were homogeneous. Use of pooled, homogeneous data can result in a more powerful analysis (Zar 1984). We used χ^2 analysis to estimate if the overall frequency of prey items within diets of breeding and nonbreeding pairs were different We then used a *Z* Test of proportions with correction for continuity (Zar 1984) to estimate if the proportions and percent biomass of prey groups were different between breeding and nonbreeding pairs.

RESULTS

We collected pellets from 14 different spotted owl pairs, 5 breeding and 9 nonbreeding. A total of 139 individual prey items were identified (Table 1).

Diets of breeding and nonbreeding owl pairs were significantly homogeneous (breeding: *heterogeneity* $\chi^2 = 6.15$, $v = 12$, $P > 0.05$; nonbreeding: *heterogeneity* $\chi^2 = 24.56$, $v = 24$, $P > 0.05$). Overall frequencies of prey items within prey groups were significantly different between breeding and nonbreeding pairs ($\chi^2 = 8.29$, $v = 3$, $P < 0.05$). Frequencies of birds and insects were not significantly different ($\chi^2 = 0.08$, $v = 1$, $P > 0.05$); whereas, frequencies of large and small mammals were significantly different ($\chi^2 = 8.26$, $v = 1$, $P < 0.01$) Because no significant differences occurred between frequencies of birds and insects within diets of breed-

Table 1. Comparison of prey found within diets of breeding and nonbreeding California Spotted Owl pairs from the central Sierra Nevada, Eldorado County, California from May–August 1986 and 1987.

Prey	Breeding (N = 5) Frequency N	%	Biomass (g) N	%	Nonbreeding (N = 9) Frequency N	%	Biomass (g) N	%
Mammals								
W. Gray Squirrel (*Sciurus griseus*)	1	1.43	759	8.73	—	—	—	—[a]
Dusky-footed Woodrat (*Neotoma fuscipes*)	10	14.28	2270	26.11	17	24.64	3859	50.07
S.N. Golden-mantled Ground Squirrel (*Spermophilus lateralis*)	—	—	—	—[a]	2	2.90	346	4.49
N. Flying Squirrel (*Glaucomys sabrinus*)	28	40.00	3416	39.29	14	20.29	1708	22.16
Pocket Gopher (*Thomomys bottae*)	9	12.86	990	11.38	3	4.35	330	4.28
Broad-handed Mole (*Scapanus latimanus*)	2	2.86	110	1.26	4	5.80	220	2.85
Long-tailed Meadow Mouse (*Microtus longicaudus*)	1	1.43	37	0.43	2	2.90	74	0.96
Deer Mouse (*Peromyscus maniculatus*)	1	1.43	17	0.19	11	15.49	187	2.43
California Myotis (*Myotis californicus*)	1	1.43	5	0.06	—	—	—	—[a]
Birds								
Steller's Jay (*Cyanocitta stelleri*)	10	14.29	1070	12.31	9	13.04	963	12.49
Insects	7	10.00	21	0.24	7	10.14	21	0.27
Total	70	100.0	8695	100.0	69	100.0	7708	100.0

[a] Prey species not found within diet.

ing and nonbreeding pairs, further analyses were applied only to large and small mammals.

Relative proportion of large mammal prey was significantly greater ($Z = 2.63$, $P < 0.01$), while relative proportion of small mammal prey was significantly less ($Z = 3.11$, $P < 0.01$) within the diet of breeding pairs than nonbreeding pairs. Further, relative proportion of large mammal biomass was significantly greater ($Z = 14.09$, $P < 0.01$), while the relative proportion of small mammal biomass was significantly less ($Z = 14.14$, $P < 0.01$) within the diet of breeding pairs than nonbreeding pairs.

Discussion

As with Northern Spotted Owls (Solis 1983; Forsman et al. 1984; Barrows 1985), woodrats and Northern Flying Squirrels were important prey for California Spotted Owls in the Sierra Nevada. Woodrats (37.4%) and Northern Flying Squirrels (31.2%) composed most of the biomass within the diet of California Spotted Owls. Similar to Barrows (1985), our results indicated that successful breeding was correlated to the greater relative proportion of large mammal prey within the diet of California Spotted Owls. Further, our results indicated that the diet of breeding California Spotted Owl pairs had fewer and less biomass of small mammal prey than nonbreeding pairs.

Laymon's (1985) and our data (Table 1) indicated that more birds were present within the diet of California Spotted Owls than reported for either Northern Spotted Owls (Barrows 1980; Solis 1983; Forsman et al. 1984) or Mexican Spotted Owls (*Strix occidentalis lucida*) (Ganey 1988). Birds accounted for 13.7% of prey composition and 12.4% of prey biomass within the diet of California Spotted Owls.

Steller's Jay (*Cyanocitta stelleri*) was the only bird species found within the diet of owls we studied However, we may have underestimated the number of birds within the diets because we counted only bills. Remains of large prey, such as jays, can occur in several pellets (Forsman et al. 1984).

Insect occurrence for diets of spotted owls seems to be highly variable. Forsman et al. (1984) reported that insect occurrence for diets of Northern Spotted Owls in Oregon ranged from 2.3–32.5% annually and from 1.8–62.3% seasonally. Insect occurrences for diets of Northern Spotted Owls in California were 6.8% (Solis 1983), 12% and 13% (Barrows 1980; 1987, respectively). For insect occurrence within California Spotted Owl diets, we found 10.1% (Table 1) for owls in the central Sierra Nevada and

Barrows (1980) reported 17.6% for owls in southern California. Ganey (1988) reported insect occurrence for diets of Mexican Spotted Owls in Arizona was 5.3%. Therefore we suggest that spotted owls may forage opportunistically on insects.

Relative abundances of prey species within spotted owl territories was not estimated. Therefore, we cannot infer whether our results indicate a preferential selection of large mammal prey by breeding pairs or greater availability of large mammal prey within territories of breeding pairs.

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